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Field Guide for Managing Sahara Mustard in the Southwest



Forest
Service

Southwestern
Region

TP-R3-16-32

Revised July 2016

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Sahara mustard (*Brassica tournefortii*)

Mustard family (Brassicaceae)

Sahara mustard is an invasive plant that is listed as a noxious weed in Arizona and is on the watch list in New Mexico. This field guide serves as the U.S. Forest Service's recommendations for management of Sahara mustard in woodlands, rangelands, and deserts associated with the Service's Southwestern Region. The Southwestern Region covers Arizona and New Mexico, which together have 11 national forests. The Region also administers 4 national grasslands located in northeastern New Mexico, western Oklahoma, and the Texas panhandle.

Description

Sahara mustard (synonyms: wild turnip, African or Asian mustard) is an introduced, short-lived annual that is native to North Africa, the Middle East, and Mediterranean lands of southern Europe. Sahara mustard is quick growing and can complete its life cycle within a few months. New plants are commonly seen following fall and winter precipitation and are difficult to differentiate from native mustards as they are similar in shape and form.

Growth Characteristics

- Annual broadleaf plant; average height is 3 inches to 3 ft. tall flower stalks.
- In early growth plants form a large basal rosette with leaves 3-12 inches long that are deeply lobed and toothed; leaves are present on inflorescences but they later rapidly decrease in size and appear as small bracts; stems and leaf surfaces may be covered with simple hairs.
- Inflorescences can vary widely in size depending upon the health of plants; ranging from 4-40 inches in height. Inflorescences consist of racemes that include anywhere from 6 to 20 flowers.
- Flowers are small and dull yellow, often making them inconspicuous. Petals consist of two pairs that form a cross-like shape and are only slightly longer than the length of sepals. In the Southwest, adult plants typically flower from February–April and then senesce by May.

- Fruits is a specialized structure called a silique that can actively dehisce when mature. Siliques are 1.4-2.6 inches long with an obvious beak at the tip of the fruit. Siliques contain 14-30 seeds (0.04 inches in diameter) that are red with a mucilaginous coating.

Ecology

Impacts/Threats

Sahara mustard takes early advantage of fall and winter soil moisture and can develop dense, monotypic stands resulting in lower diversity of flora and fauna species. As the foliage and flower stalks dry up, the litter material can become a fire hazard capable of spreading fire into areas where native plants are typically fire intolerant.

Site/Location

Although it favors sandy soils, Sahara mustard occupies a wide variety of disturbed, arid habitats. It is commonly found along bladed and mowed roadsides and other areas disturbed by machinery. However, Sahara mustard does not require soil disturbance to be invasive.

Sahara mustard has been observed across a number of areas in the Mojave and Sonoran deserts including residential and industrial areas, ephemeral riparian corridors, rangeland and pastures, and cultivated fields. While this plant is not yet common in New Mexico, it has expanded rapidly in Arizona, Nevada, and California.

Spread

Sahara mustard spreads exclusively by seed; however, more knowledge is needed to learn about the biology, reproduction, and spread of this species. Well-developed plants produce 750-9,000 seeds that reportedly remain viable for more than 3 years. Seeds may germinate with as little as 1.5 inches of rainfall. Rodents cache seeds and may be capable of moving flower heads and seed far from their source thereby enhancing spread. Seed spread occurs with wind as dry plants easily break off at ground level and tumble across the landscape, spreading seed into new locations. Dried seed and plant fragments also adhere to surfaces and undercarriages of vehicles and road maintenance equipment.

Invasive Features

Sahara mustard is well-adapted to desert landscapes and is likely to continue its spread into unfilled niches. With its high capacity for seed production and ability to rapidly propagate under low soil moisture conditions, this weed should be expected to thrive across a wide range of habitats. Successful management prevents seed production/spread.

Management

The best approach for Sahara mustard control is early detection and proactive management since well-established stands are difficult to control. Since this plant is not well established in New Mexico, actively eradicating new infestations is highly encouraged. The following actions should be considered when planning an overall management approach:

- Healthy plant communities should be maintained to limit Sahara mustard infestations. If necessary, include revegetation methods to reduce the possibility of further invasion.
- Eradicate new populations of Sahara mustard as early as possible.
- Combine mechanical, cultural, biological, and chemical methods for most effective Sahara mustard control.
- Detect, report, and map large infestations. Keep annual records of reported infestations.

Table 1 summarizes some management options for controlling Sahara mustard under various situations. Further details on these management options are explained below. Choice of individual control method(s) for Sahara mustard depends on the extent and density of infestation, current land use, and site conditions (accessibility, terrain, microclimate, other flora and fauna present, etc.). Other important considerations include treatment effectiveness, overall cost, and the number of years needed to achieve control. More than one control method may be needed for a particular site.

Physical Control

Although labor intensive, physical methods used consistently and repeatedly are effective at controlling Sahara mustard. In general, effectiveness of physical methods is improved when combined with herbicide control.

Manual Methods

Hand-pulling or hoeing – Plants of all ages are easily controlled by hand-pulling, hoeing, or grubbing; but removal is best before flowering and seed set. Always remove as much of the above and below-ground plant parts as possible, and dispose of debris by bagging and depositing bags in a landfill, or by burning.

Mechanical Methods

If using machinery to manage Sahara mustard, the equipment should be cleaned to prevent movement of seeds or root fragments to un-infested areas.

Mowing – Without serious attention, mowing can contribute to further spread and increased densities of Sahara mustard. However, mowing is a helpful tool for removing accumulated leaf and early flower material. For best results, mow Sahara mustard at the early bolting or flower bud stage to prevent seed production. Monitor plants carefully and repeat mowing if the weed produces new flower shoots.

Tillage – By itself, cultivation is often not a viable alternative for Sahara mustard control. Shallow disking will effectively eliminate new plants, but disturbing the soil surface may enhance later seed germination. Cultivation combined with later well-timed herbicide use can reduce population size in areas suitable for these practices. Research using this integrated approach is limited, however.

Prescribed Fire

Burning actively growing Sahara mustard with prescribed fire is usually impractical and is not recommended. Flaming or spot burning individual plants in areas with low wildfire severity conditions may be a suitable alternative to physical control to prevent soil disturbance. Piling pulled or hoed growth material and burning is an acceptable way to dispose of plant debris.

Table 1. Management options*

Site	Physical Control	Cultural Control	Biological Control	Chemical Control
Roadsides, trails, or non-crop areas	Mow at early flower stage; apply herbicide to re-growth. Hand-pull or hoe small patches.	Use seed, mulch, and fill materials certified to be weed-free. Clean machinery following activity in infested areas. Train road crews and the public to identify and report infestations; map reported populations.	Biocontrol agents are unavailable.	Spray at early leaf stage before flower bolt. For ground application, use truck-mounted or tractor-pulled spraying equipment. Wash underneath vehicle after application to prevent spread.
Rangeland or pasture	Disking in early growth can eliminate the weed; consider combining any cultivation with follow-up herbicide control. Fire, except as spot burning, is not recommended.	Use seed and forage hay certified to be weed-free; use pellets for horses in back-country areas. Monitor areas where soil was imported or hay bales were used for erosion control. Re-seed with plants that are desirable and will provide competition.	Use of a grazing strategy to reduce or eliminate Sahara mustard has not been researched. Manage grazing closely to prevent overuse. Biocontrol agents are unavailable.	Spray at early leaf stage before flower bolt. For ground application, use truck-mounted or tractor-pulled spraying equipment. Wash under vehicle after application to prevent spread. Spot spray sparse populations; use a backpack or hand held sprayer.
Riparian areas, wilderness and other natural areas, and/or small infestations	Hand-pull or hoe small patches; remove as much of the root as possible; bag and dispose of debris appropriately.	Use seed and forage hay certified to be weed-free; use pellets for horses in back-country areas. Educate the public to identify and report infestations. After passing through infested areas, inspect and remove any seed or root fragments from animals, clothing, and vehicles.	Same as above.	Same as above.

* Choice of a particular management option must be in compliance with existing regulations for the land resource.

Cultural Control

Early detection and plant removal are critical for preventing Sahara mustard establishment. Land managers, the local public, and road crews should be educated as to how to identify Sahara mustard in all life stages so they can help report suspected infestations. Seed and materials used for mulch, forage, or fill should be certified to be weed-free; pellets may be used for horses in back-country areas. Vehicles, humans, and livestock should be discouraged from traveling through infested areas to minimize seed spread.

Biological Control

Grazing

There is little research or practical experience reported related to grazing Sahara mustard by livestock. However, caution should be exercised when grazing these areas as other plant members of the mustard family are known to be poisonous to goats, sheep, horses, and cattle.

Classical Biological Control

There are no classical biocontrol agents (insects, pathogens, etc.) that have been approved by USDA for managing Sahara mustard.

Chemical Control

Herbicides can be an effective tool for managing Sahara mustard, especially when used as part of an integrated strategy. Numerous herbicides are available that can easily control Sahara mustard as well as other annual members of the mustard family. Herbicide choice depends on local conditions, label restrictions, land use objectives, and cost. See table 2 for a summary of some effective herbicide choices. Each herbicide product will have different requirements and restrictions according to the label. Read and understand prior to any application. Consult the registrant if you have questions or need further detail.

Herbicide Application

Herbicide applications should be made in early leaf stages of development and always before flowering. If young plants or seedlings are found, apply herbicides as soon as possible to prevent them from producing flower heads or seed. If the majority of plants have already produced fruits, then plants should be hand-pulled or hoed and removed from the site.

Herbicides may be applied with backpack or hand-held sprayers, ATV or UTV sprayers, or conventional boom sprayers that are pulled or attached to a tractor or truck. Any equipment used to spray herbicide should be calibrated. For sparse populations, one person or a small team can spot spray Sahara mustard. With this method, simply walk through the infested area and directly spray the foliage of individual plants without dripping by using an adjustable spray nozzle attached to a hand-held or backpack sprayer. Precautions should be taken if non-target plants (including woody species) need to be protected from herbicide application. This includes situations where spray drift, soil erosion, or water movement potentially could occur.

Management Strategies

Management of Sahara mustard should involve (1) careful planning, (2) a rapid response to control treated plants and new infestations, and (3) a long-term commitment to management actions. Combining methods, as outlined in this guide, should always be considered in controlling Sahara mustard. For example, physical methods (such as

shallow disking) used in combination with follow-up chemical control can be effective. To enhance long-term control, consider a management approach that encourages and maintains competitive desirable plants. A healthy, well-maintained population of native plants can dramatically slow the introduction and spread of Sahara mustard.

Frequent scouting for new populations should be conducted to control newly emerged seedlings. Surveying should be conducted after major rain events in early winter through spring to detect rosettes that form the leading edge of expanding populations. When new infestations are discovered, plants should be removed immediately to prevent further spread. Small or isolated infestations on otherwise healthy sites should be given high priority for treatment, followed by treatment of corridors such as roadways and hiking trails that act as pathways for spread.

Regardless of the strategy used, Sahara mustard typically cannot be effectively controlled within a single year or by using only one method. Complete eradication will likely require 3 to 10 years of repeated methods for control. Since it is ordinarily useless to treat an area only one time without retreatment, sufficient resources must be allocated for the area where control is attempted. After initial treatment, it is important that resources are also available to respray or retreat the treated area as necessary. Follow-up treatments should then be implemented to capture new or returning plants. Previously treated areas should always be monitored to detect and control recovering Sahara mustard.

References and Further Information

- Brooks, M.L., J.V. Draper, and M.R. Trader. 2006. Controlling Sahara mustard: evaluation of herbicide and mechanical treatments (California). *Ecol. Restor.* 24: 277-278.
- Deuser, C. 2005. Sahara mustard control strategies. Sahara mustard workshop. Available at http://www.cal-ipc.org/ip/research/saharan/pdf/SahMust_ControlStrat.pdf (accessed July 2014).

Table 2. Herbicide recommendations

Common Chemical Name (active ingredient)	Product Example ¹	Broadcast Treatment (rate per acre)	Spot Treatment (spray solution) ²	Time of Application	Remarks
2,4-D ester or amine ³	Several products and manufacturers	Depends upon formulation (1-2 lbs. ae)	3 to 5%	Spring	Selective; apply in early leaf stage. If infestation is dense, mow first and apply to re-growth before flower stage.
Aminopyralid	Milestone	1/4 to 1/3 pint	3 to 5%	Same as above.	Broadleaf-specific herbicide; does not harm grasses. Best applied as a course low-pressure spot spray. Use 0.25% -0.5% v/v NIS when conditions are adverse (high heat, low relative humidity or dusty conditions) or on mature stands. ⁴ Labeled for use up to water's edge. Some grazing recommendations. May be used in combination with 2,4-D.
Aminopyralid + metsulfuron methyl	Opensight Chaparral	2.5 to 3.3 oz./acre	n/a	Spring or fall	A selective granule herbicide for use on non-cropland, rights-of-way, non-irrigation ditch banks, natural areas, and grazed areas in and around these sites.
Clopyralid	Curtail [others available]	2 to 3 quarts	1 to 3%	Same as above	Broadleaf-specific herbicide; does not harm most established grasses. Wait 30 days to establish perennial grasses. Can be used on rangeland, irrigated pasture or meadow, but not directly to water. Not recommended for highly permeable soils or shallow groundwater areas. May be used in combination with 2,4-D. May use up to 0.5% v/v NIS. ⁴
Dicamba + 2,4-D ³	Weedmaster	2 to 4 pints	1 to 3%	Seedling to rosette stage	Selective with a broad spectrum; may affect some sensitive pasture grasses such as bentgrass and legumes like alfalfa. Not for use near water.
Metsulfuron-methyl	Escort Ally [others available]	0.5 to 1.0 oz.	n/a	Early leaf stage; usually fall or winter	Selective; safe for most perennial grasses; add 0.25% v/v NIS. ⁴ Not for use near irrigation water. Apply to green healthy plants. May be used in combination with 2,4-D.
Triclopyr	Garlon 3A Remedy [others available]	3 quarts	3 to 5%	Same as above.	Selective; safe for most perennial grasses; add 0.25% v/v NIS ⁴ ; labeled for riparian areas and use near water bodies.

¹ Trade names for products are provided for example purposes only, and other products with the same active ingredient(s) may be available. Individual product labels should be examined for specific information and appropriate use with Sahara mustard.

² Spray solution is the herbicide/water ratio in a spray mix that may be used for spot treatment with backpack or hand-held sprayers. The amount of product applied during an annual growing season must not exceed the maximum application rate per acre as specified by the product label – refer to the product label for the site type and application.

³ 2,4-D is a restricted use pesticide in New Mexico only. A certified applicator's license is required for purchase and use.

⁴ NIS is an abbreviation for non-ionic surfactant which is an additive commonly recommended by herbicide labels for post-emergent foliar application of herbicide.

Graham, J., W.S. Johnson, and E. Powell. 2002. Identifying and managing Sahara mustard. Univ. of Nevada Fact Sheet-05-02. Available at <https://www.unce.unr.edu/publications/files/nr/2005/FS0502.pdf> (accessed July 2014)

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Suggested Websites

For information on invasive species:

<http://www.invasivespeciesinfo.gov/>

<http://www.invasive.org/weedus/index.html>

For information about calibrating spray equipment: NMSU Cooperative Extension Service Guide A-613 Sprayer Calibration. Available at http://aces.nmsu.edu/pubs/_a/A-613.pdf

Herbicide labels online: <http://www.cdms.net/>



**For more information or
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